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Essential Requirements of PPAP

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***Abstract*— In today's competitive environment industries are using various quality standards, such as ISO, TS, APQP etc. While applying these standards in any organizations there are certain procedures. Extensive technical documentation is the major requirement of every standard mentioned above. The Production Part Approval Process is one of the quality assurance procedures which is necessary in now days, especially in Automotive industries. The purpose of Production Part Approval Process (PPAP) is as follows.**

1) To provide the detailed information including design process, production process, inspection to the customer.

2) To assure the customer that the current manufacturing process is able to fulfill the requirement and special demands of the customer.

Keywords- PPAP; PPAP Documents, PPAP Submissio; Production Part Approval; Quality Assurance.

I. INTRODUCTION

PPAP submission is required when

1) At the time of submission of new product by existing or new supplier.
2) At the time of changes to existing product. They may incorporate change in components, change in dimensions, and change in production process.

Table I shows the levels of PPAP used in present practice.

TABLE I. LEVELS OF PPAP

Level no	Description
1	Part submission warrant only
2	Part submission warrant with samples and limited supporting data
3	Part submission warrant with complete data and samples
4	Part submission warrant defined as per customer requirements
5	Part submission warrant with samples supporting and complete supporting data. It will observed at the suppliers end

As this is a tedious and extensive process, it requires detailed technical documentation .There are minor changes in this documentation depending upon the organization and field. But in general the documents related to design process, manufacturing process, inspection process are common .Here our aim is to give brief information about the documentation that is required for submission of PPAP. For the customer's satisfaction following are the essential documents required at the time of PPAP submission.

II. DOCUMENTS REQUIRED FOR PPAP SUBMISSION

Following documents are required at the time of PPAP Submission.

1) Part submission warrant.
2) Design record documentation
3) DFMEA documents
4) Process flow diagram
5) Engineering Change documents
6) Process Failure Modes and Effects Analysis documentation
7) Control Plan documentation
8) Measurement system documentation
9) Documents related to material of product
10) Outside laboratory documentation

A. Part Submission Warrant

It is the document that shows the status of the product i.e. either it is approved or rejected by the customer. The format and data of PSW can vary depending on the organization, but in general it contains following basic information.

- Name of the supplier
- Address of supplier
- Level of submission
- Date and reason of submission
- Status i.e. either accepted or rejected by customer

B. Design records documentation[i]

It includes the drawings of the assembly of the product (if any) as well as the drawings of details with required dimensions, annotations and tolerance.

C. DFMEA documentation

It contains DFMEA analysis of critical parts of the product. It shows the potential modes of failures and related risks. It is

the most significant part of PPAP documentation because it gives guidelines about design failure modes, their effects and actions taken to avoid that type of Failure. Following factors should be considered at the preparation time of DFMEA

Part name: - Name of the component for which the DFMEA analysis is prepared.

- Requirements:-It represents the function of that particular part.
- Potential Failure Modes:-It represents the different modes of failure that can occur.
- Potential Effects of Failure:-It describes the effects caused due to the failure.
- Severity: no:- Depending on the seriousness of the failure , it is numbered from 1 to10.
- Occurrence no:-Depending on the frequency of the failures ,it is numbered from 1 to10
- Detection:-Depending on possibilities of detection ,it is numbered from 1 to 10
- Risk Priority Number:-The product of the three columns i.e.(Severity, Occurrence, Detection) is called as Risk Priority Number.

In general when the RPN number exceeds to 100 then it is considered as critical condition and the action must be taken in that case. Also in addition to this there another three variables i.e. Potential causes of failures, current practices to overcome the failures, recommended actions and the target date for the completion of action

D. Documents related to Process flow diagram [ii]

The purpose of any process flow diagram is to describe each and every stage in the manufacturing of the product. Some customers can ask process flow diagram of each part while in general the process flow diagrams of critical parts should be submitted. In general following is the format of process flow diagram The first five columns is standard. However the terms product characteristics defines in what way the operation/inspection should be done and the term process characteristics describes the requirement of customer.

E. Engineering Change Documentation

If there is any change made by supplier in the drawings of Product (though it is minor) as per requirement of customer ,then it should be approved by both ends and should be incorporated in PPAP.

F. Documents related to the Process Failure Mode Effect Analysis

The documentation related to PFMFEA should be prepared in the same manner as DFMEA. Only the parameters are different .In DFMEA the parameters are related with design, while in PFMEA the parameters or operations are related with the process such as cleaning, testing, coating etc.

G. Control plan documentation [iii]

The control plan is the authorized document that describes the operations, various processes, material used for that particular product/part. The purpose of control plan is to control the variations in the key parameters. In production shop the control plan of the product/part should be there at the time of production. Without control plan no operation should be carried out. The sample control plan is given below .In general the control plan gives the guide line that in what way a particular part should be manufactured

Following are the factors that should be included in control plan

- Step No.:- It indicated operation/process no.
- Operation description:-It indicates the main operation to be carried out.
- Manufacturing tools:- It gives the information regarding various tools such as jigs, fixtures, CNC,Lathes during manufacturing.
- Characteristics of product/process:- It indicates the sub operations that incorporates in main operation.
- Specifications:- It describes various specifications such as dimensions ,tolerance or any other regarding the operation
- Measurement techniques:-It describes the measurement method for that particular part and instrument used to take the measurement.
- Sample size:- It describes the sample size to be taken for inspection based on some standards.
- Control method:-It describes the method used to control that particular operation sometimes it is in process inspection sometimes it may be of any other type.
- Responsibility:- It indicates name or designation of the person in the organization who is responsible for the said operation.
- Along with that the other information such as part name, part number, product name, contact person and their contact no. should be included in the control plan for the administrative purpose. The control plan should be prepared for each and every part to be manufactured.

H. Measurement system documentation [iv]

It is a mathematical or statistical technique to determine the variance in current manufacturing process. It is used to ensure the use of effective measurement system for current production. The crucial part of this documentation is Gauge R &R study i.e. Gauge repeatability and reproducibility. Here there is a sample format of the Gauge R& R study. First choose the persons in the organizations who are working on that job. Choose at least three persons. Take ten sample components; Take at least three trials from each person. Choose the maximum and minimum value and calculate the range. Observing this statistics you can make conclusion about the variance of measurement system. If the variation is above 30to40% the system is not effective.

I. Material testing documents

The results of various tests on product material such as hardness test, Impact test, and composition of the material should be submitted**.** to the customer.

J. Laboratory related documents

It is generally applicable to measuring instruments. All the measuring instruments should be calibrated from a calibration agency approved by NABL or NPL (for India) and the documents should be submitted to the customer. So In general it is an Overview of crucial documents that are required for submission of PPAP. In addition to this the customer may seek for process capability analysis also and Appearance approval report of a product. Along with that, it is necessary to provide the master samples to the customer with the list of checking aids.

III. CONCLUSION

PPAP is the methodology that reduces possibility of lacunas every stage from design to dispatch of the product. Hence finally it reduces or minimizes the probability of rejection. Hence both supplier and customers are the beneficiaries' .And finally it maintains the standard and quality of your product in market. As each and every thing is documented in the entire exercise there is no scope for any wrong practice. Or sometimes it is very easy to detect what is going wrong .Though sometimes it is very tedious to apply due to the heavy documentation; finally it is effective for improvement in quality as well as customers satisfaction.

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ANNEXURE

[i] Sample format of DFMEA

[ii] Sample format of process flow diagram

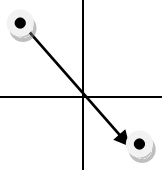
[iii]Sample format of control plan

[iv]Sample format of Gauge R&R study

Annexure No. i Sample format of DFMEA

Sr.	Part name	Requirements	Potential Failure Modes	Potential effects of failures	Severity	Occurrence	Detection	RPN
1	Centrifuge	To clean the dirt from engine oil	Centrifuge operates under threshold pressure	Engine starves of oil	8	1	1	8

Annexure No. ii Sample format of process flow diagram

Op.No.	Storage	Inspection	Operation	Outsource activity	Description	Product characteristics	Process characteristics
10					store	Cover all the centrifuges with the provided kit	Prevent from rust
20					Leak testing	No leakage at 5 bar pressure	Air Pressure 5 Bar, Temperature Ambient

Annexure no.iii Sample format of control plan

Step No.	O/P Description	Manufacturing tools	Characteristics of product or process	Specification or Tolerance	Measurement Technique	Sample size	Control Method	Responsibility
10	1 st side turning	CNC lathe	Step O.D.	24.5+0.02	Vernier caliper	every First off and in process inspection per lot.	In process inspection	In process inspector

Annexure no.iv) Sample format of Gauge and R&R study

Inspector	Inspector 1				Inspector 2				Inspector 3			
Sample	Trial 1	Trial 2	Trial 3	Range	Trial 1	Trial 2	Trial 3	Range	Trial 1	Trial 2	Trial 3	Range
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
Total				R1				R2				R3

R=R1+R2+R3
UCL R= D4 X R(Upper control limit of R)
LCL R= D3 X R(Lower control limit of R)
X1=(Trial1+ Trial2+Trial3)/3 similarly calculate X2 and X3.And calculate the difference between the maximum and minimum value of X.
Where D4 and D3 are standard constants